

STP01

SOIL TEMPERATURE PROFILE SENSOR

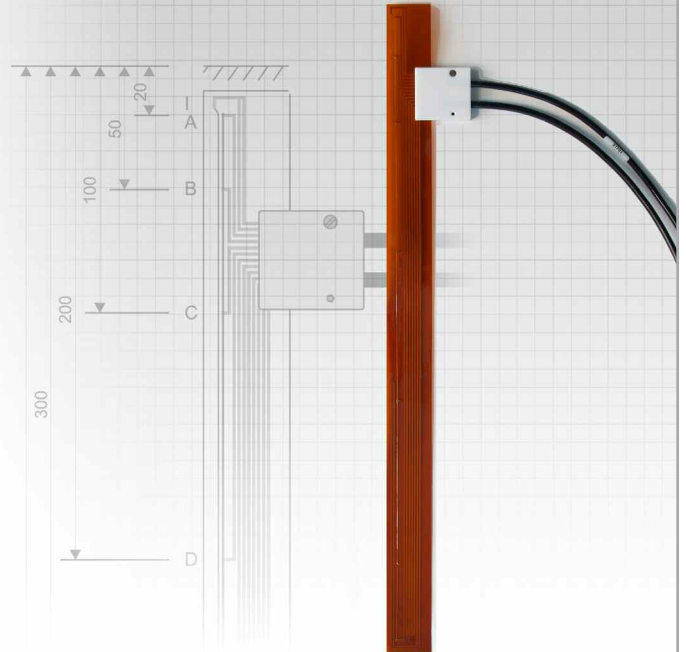
The STP01 temperature profile sensor is intended for high accuracy temperature measurement within soil over multiple depths (also known as soil temperature gradient). An integrated heating wire within the sensor offers the possibility of performing an insitu sensor self-check when energized, for enhanced measurement quality assurance. The possibility of determining soil thermal conductivity as a function of soil depth is also possible with the STP01.

Soil temperature profile determination is suitable for a range of applications, in particular soil energy balance studies. The STP01 incorporates 5 thermocouples (tc's) located at 2, 5, 10, 20 and 50 cm depth, and one additional reference Pt-100 RTD, also at 50 cm depth (see Figure 1 right). A key design feature of the STP01 is its central copper-nickel (CuNi) wire (5). By incorporating the reference tc junction within the sensor and only measuring differential tc voltages relative to a single reference tc, record breaking gradient measurement accuracy is achievable down to $\pm 0.02^\circ\text{C}$. Insulated copper (Cu) stranded wire is also used in the construction of the STP01 signal cable. The heater wire (6) spans 280 mm from I to II. The response of the tc's to an induced heat pulse (tc pulse response) also makes it possible to remotely validate sensor performance in the field.

APPLICATIONS

- ▶ Soil temperature studies
- ▶ Soil temperature gradient measurement
- ▶ Energy balance & heat flux determination

Note: Above applications are inclusive of, but not limited to the entire STP01 application range.



STP01 SENSOR SPECIFICATIONS

Thermocouples, tc:	Cu-CuNi, type T
Temperature range:	-30 to +70° C
Depths below soil surface:	2, 5, 10, 20 & 50 cm (± 0.1 cm)
Reference junction:	Pt-100 DIN class B
Thickness (nominal):	0.6 mm (2.5 at Pt-100)
Required readout:	4 diff volt, 1 common ground, Pt-100, 4 or 3 wire

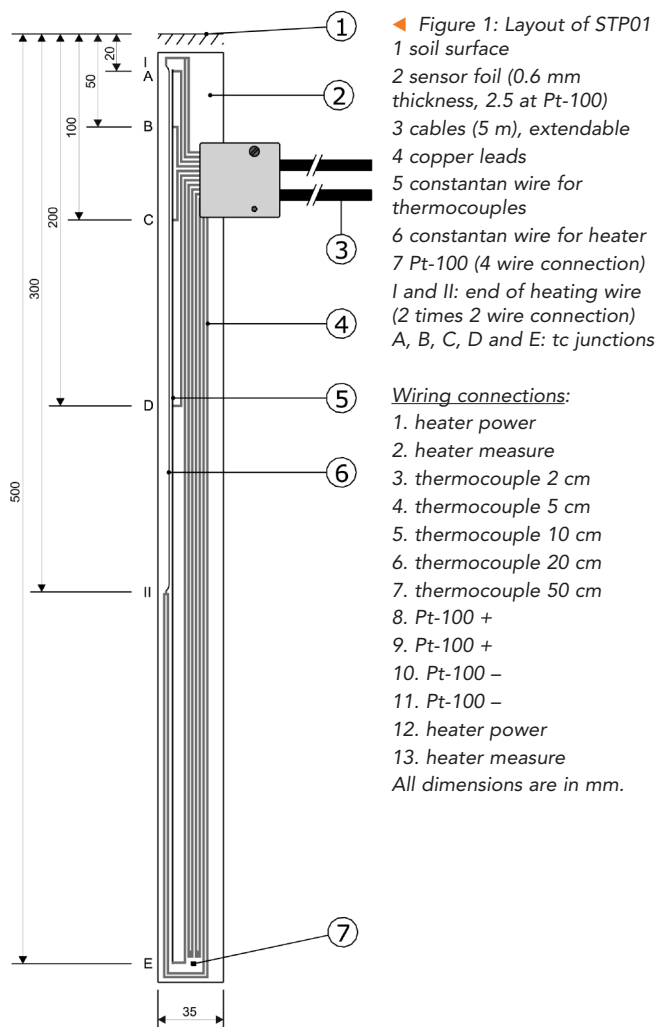
HEATER SPECIFICATIONS

Resistance (nominal):	200 Ω
Voltage input:	9-15 VDC
Duration of self-test:	± 10 min at 0.3 Watt
Average power consumption:	0.05 Watt
Required readout:	1 diff volt
Self-test recommendation:	every 3 hours, or every 24 hours min.

OPTIONS

Extended cable per meter (add to the standard length of 5 m) Insertion tool IT01. Also see ST01 model

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DATA ACQUISITION AND CONTROL

Solutions for measurement and control: See STP01 ops manual, or inquire with Hukseflux. Example programs for Campbell Scientific CR10X and CR1000 are available upon request free of charge.

MANUALS

The STP01 operations manual is available free of charge as a PDF file via e-mail upon request.

STP01 ADVANTAGES

The STP01 offers several advantages over competing sensor designs:

- ▶ High accuracy gradient measurement via accurate tc junction placement (within ± 1 mm, and measurement of tc voltages relative to reference 50 cm tc junction ($\pm 0.02^\circ$ C is achievable)
- ▶ High accuracy and stability due to relative distance between tc junctions (within ± 0.5 mm)
- ▶ Ultra thin 0.6 mm thick sensor construction (contrary to conventional stick designs), does not impede normal soil thermal flow pattern
- ▶ Extendable all copper (Cu) signal cabling
- ▶ Easy quality assurance & servicing: remote insitu sensor self-check via induced heat pulse.

EXPERIMENTAL USE:

SOIL THERMAL CONDUCTIVITY MEASUREMENT

The tc pulse response (generated by activation of the heater wire) can be used to calculate soil thermal conductivity at 3 depths: 5, 10 and 20 cm. The well established thermal needle, or non-steady-state probe technique, is applicable; for detailed theory please refer to the Hukseflux TP02 sensor operations manual. ($T = A \cdot \ln(t) + B$, with T temperature, t time, A a function of geometry, power and thermal conductivity); further consideration should however be taken, as that thermal conductivity measurement accuracy is not specified by Hukseflux for the STP01. The thermal conductivity mode is intended for experimental use only.